

# ***Reduction of Mercury Emissions from Coal-Fired Electric Utility Boilers***

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**Presentation at the  
DOE/NETL's Mercury Control Technology R&D Program Review  
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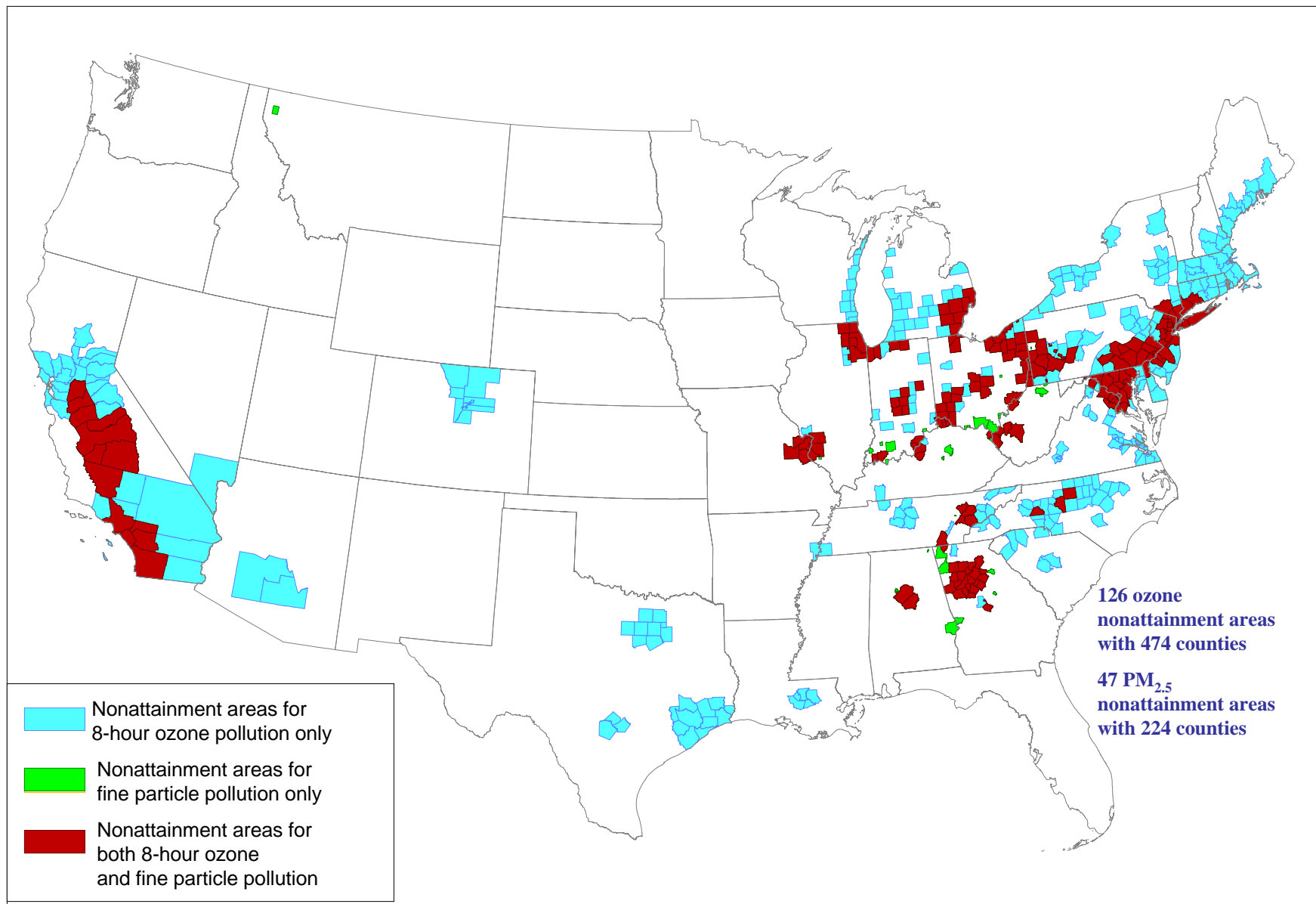


# *Outline*

- Background
  - Environmental concerns
  - Emissions
- Clean Air Interstate Rule (CAIR)
- Clean Air Mercury Rule (CAMR)



# Areas Designated Nonattainment for Ozone and $PM_{2.5}$ NAAQS in 2004





# Mercury Concerns

- Concentrations of mercury in the air are usually low. However, atmospheric mercury falls to Earth through rain, snow and dry deposition and enters lakes, rivers and estuaries. Once there, it can transform into, **methylmercury**, and **can build up in fish tissue**.
- **Americans are exposed to methylmercury primarily by eating contaminated fish.**
- Because the **developing fetus** is the **most sensitive to the toxic effects of methylmercury**, women of childbearing age are regarded as the population of greatest concern.
- Children who exposed to methylmercury before birth may be at **increased risk of poor performance on neurobehavioral tasks**, such as those measuring attention, fine motor function, language skills, visual-spatial abilities and verbal memory.
- Methylmercury exposure may **also** result in **cardiovascular and other health effects**.
- **Ecosystems may be affected by mercury deposition.**

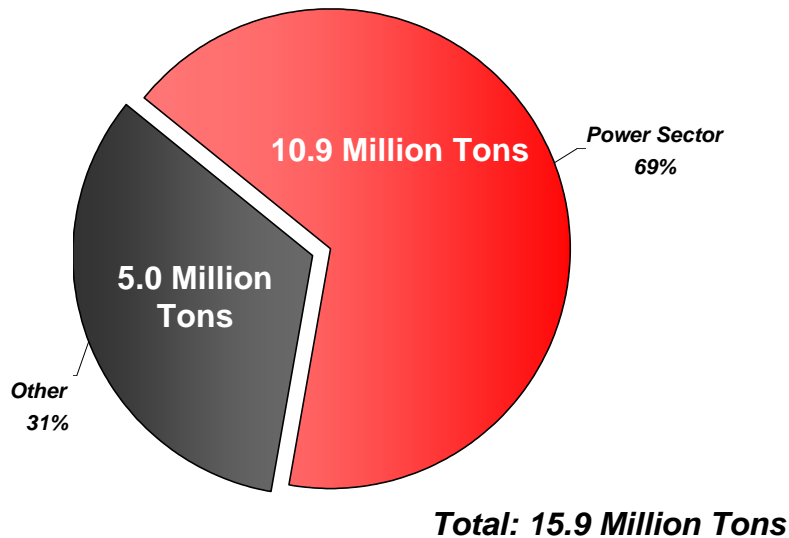




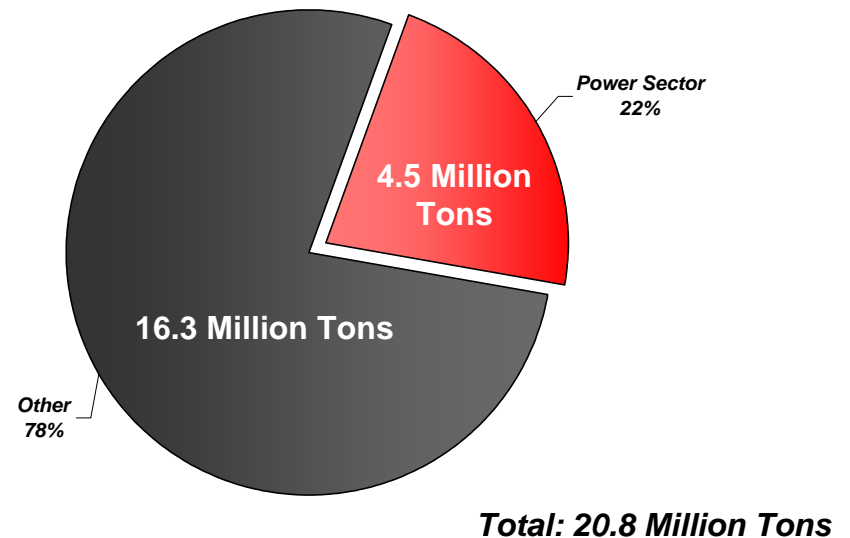
# *Electric Power Generation: A Major Source of Air Emissions*

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## **SO<sub>2</sub> Emissions**



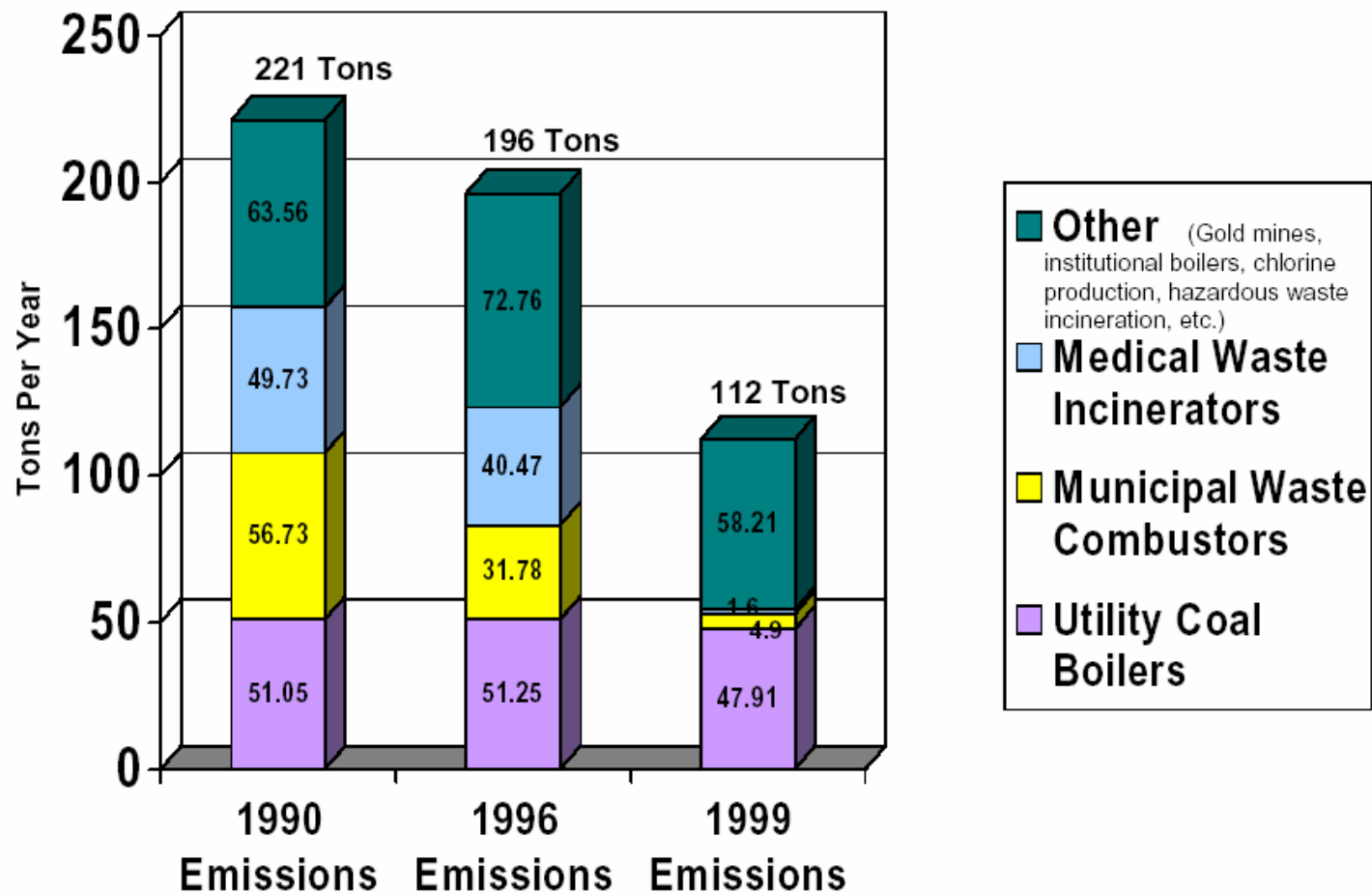
## **NO<sub>x</sub> Emissions**



Source: SO<sub>2</sub> and NO<sub>x</sub> data is from EPA's 2003 National Emissions Inventory. "Other" sources of pollutants include transportation and other mobile sources and industrial sources.



# *U.S. Emissions of Human-Caused Mercury Have Dropped 45% since 1990*



Source: EPA

**Note:** 1999 emission estimate for utility coal boilers is based on 1999 Information Collection Request (ICR); 1990 and 1996 are based on different methodology.



# *Two Ways to Address Emissions from Power Plants*

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- The President's proposed **Clear Skies legislation** is the preferred approach to achieving multi-pollutant emission reductions:
  - Multipollution caps apply to entire country.
  - Legislation can provide more certainty and less complexity.
- Use of **existing Clean Air Act authority** to address emissions:
  - Concerns related to power plant emissions demand we act now.
  - CAIR and CAMR will provide significant reductions in emissions from power plants in a highly cost-effective manner.



# *Clean Air Interstate Rule (CAIR)*



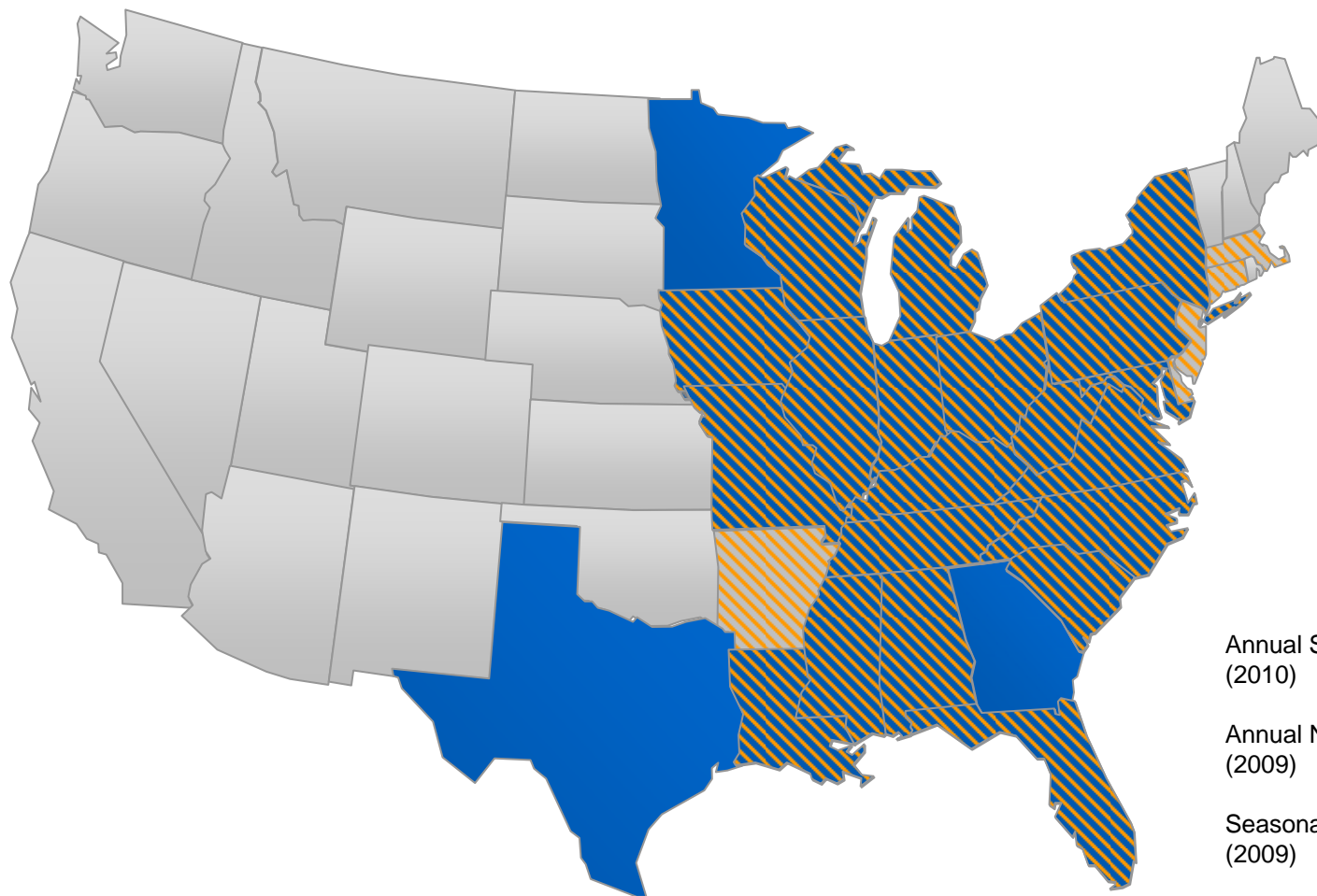
# *The CAIR Approach*

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- Determine if a **significant contribution** is projected from individual states on ozone and PM nonattainment in 2010, to define **geographic boundaries** covered by the rule.
- Analyze sources of highly cost effective reductions of SO<sub>2</sub> (for PM<sub>2.5</sub>) and NO<sub>x</sub> (for PM<sub>2.5</sub> and ozone).
- Create a **two-phase program** with declining emission caps for NO<sub>x</sub> in 2009 and 2015, and for SO<sub>2</sub> in 2010 and 2015 based on application of highly cost effective controls to large EGUs.
- Develop an **emissions budget for each state** that chooses to achieve its emission reduction requirements based on reductions from EGUs. Create parallel emission reduction targets for States that choose to control other source categories.
- Create an **optional cap-and-trade program** similar to current Acid Rain Program for SO<sub>2</sub> (Title IV) and the NO<sub>x</sub> SIP call.



# CAIR: Affected Region and Emission Caps



- States not covered by CAIR
- States controlled for fine particles (annual SO<sub>2</sub> and NO<sub>x</sub>)
- States controlled for both fine particles (annual SO<sub>2</sub> and NO<sub>x</sub>) and ozone (ozone season NO<sub>x</sub>)
- States controlled for ozone (ozone season NO<sub>x</sub>)

## Emission Caps\*

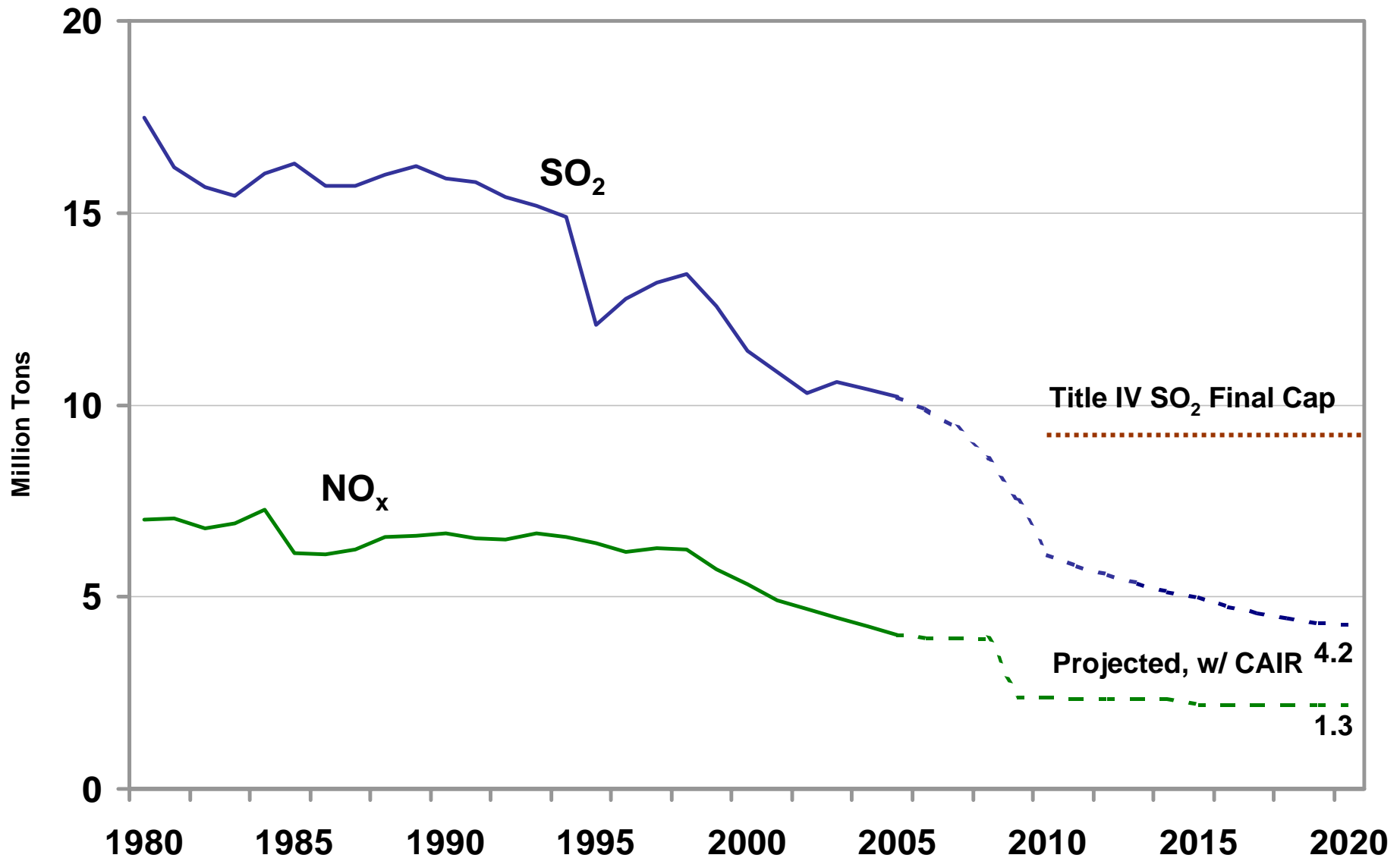
(million tons)

	<u>2009/2010</u>	<u>2015</u>
Annual SO <sub>2</sub> (2010)	3.6	2.5
Annual NO <sub>x</sub> (2009)	1.5	1.3
Seasonal NO <sub>x</sub> (2009)	.58	.48

\*For the affected region.



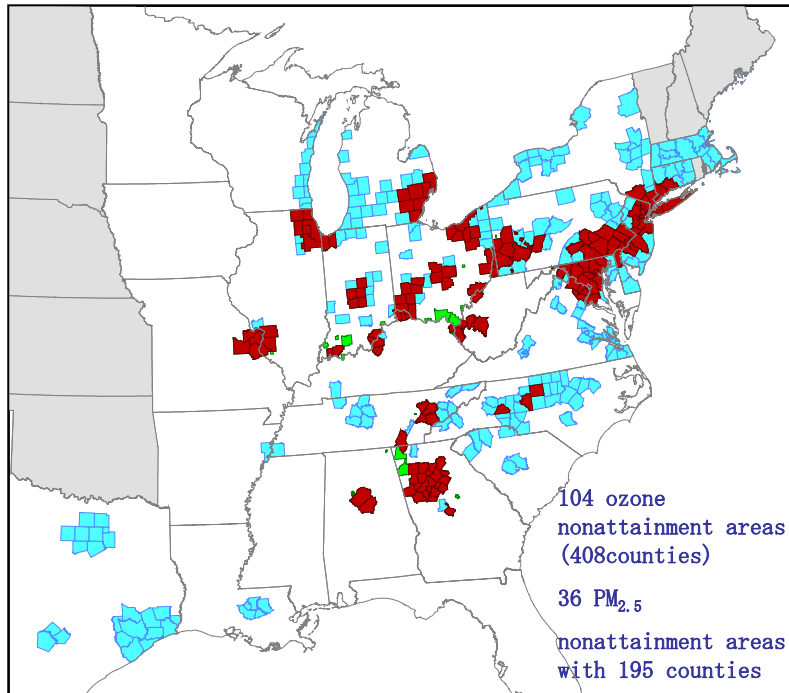
# Nationwide $\text{SO}_2$ and $\text{NO}_x$ Emissions from the Power Sector



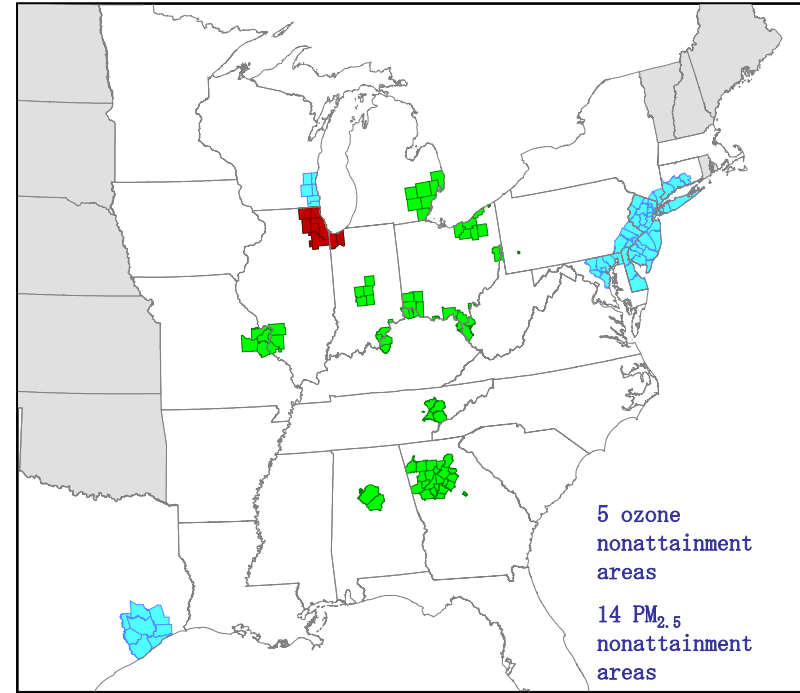





# *Ozone and Particle Pollution: CAIR, together with other Clean Air Programs, Will Bring Cleaner Air to Areas in the East - 2015*

**Ozone and Fine Particle Nonattainment Areas (April 2005)**



**Projected Nonattainment Areas in 2015 after Reductions from CAIR and Existing Clean Air Act Programs**



-  Nonattainment areas for 8-hour ozone pollution only
-  Nonattainment areas for fine particle pollution only
-  Nonattainment areas for both 8-hour ozone and fine particle pollution

Projections concerning future levels of air pollution in specific geographic locations were estimated using the best scientific models available. They are estimations, however, and should be characterized as such in any description. Actual results may vary significantly if any of the factors that influence air quality differ from the assumed values used in the projections shown here.

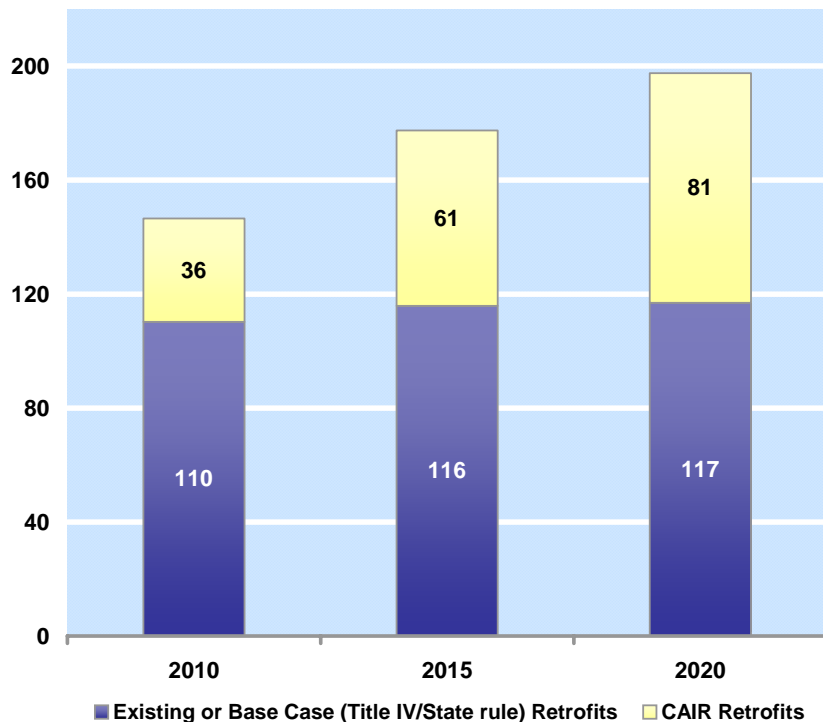


# Summary of Projected Coal Capacity with Pollution Control Retrofits under CAIR

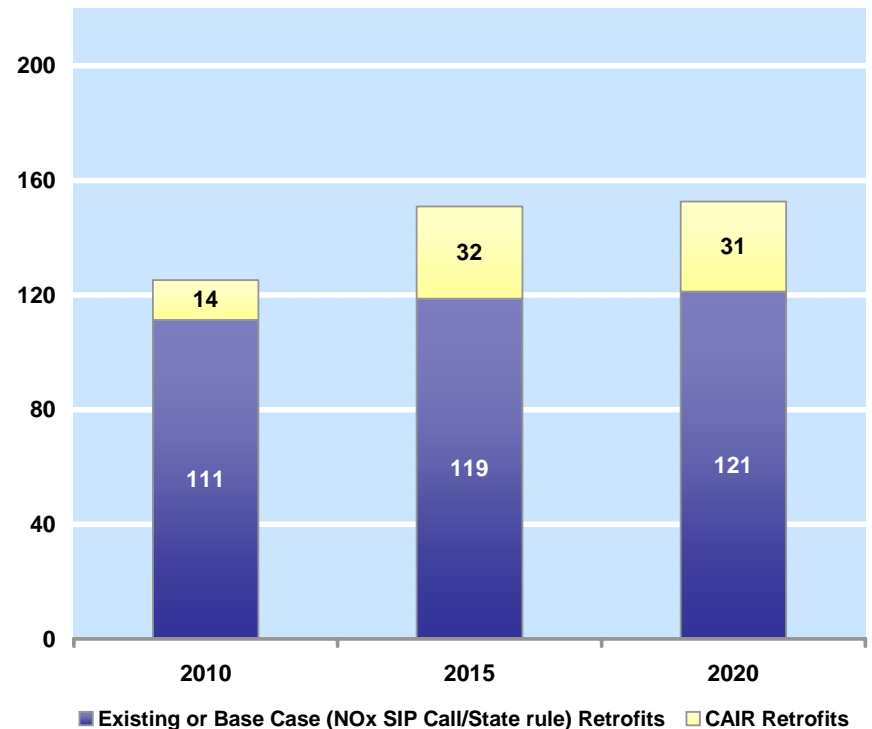
- **Total Coal Capacity Projected, with CAIR:**

- 305 GW in 2010
- 304 GW in 2015
- 320 GW in 2020

**Projected Coal Capacity w/ FGD (GW)**



**Projected Coal Capacity w/ SCR (GW)**





## *Benefits of CAIR*

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- Reduces sulfur dioxide ( $\text{SO}_2$ ) and nitrogen oxide ( $\text{NO}_x$ ) emissions which contribute to fine particle pollution ( $\text{PM}_{2.5}$ ) and ground level ozone.
- Provides substantial human health and environmental benefits – the largest benefits for any Clean Air Act rule in the last 12 years.
- Helps cities and states in the East meet new, more stringent national ambient air quality standards for ozone and fine particles.
- Emission reductions occur while economic strength is preserved. U.S. maintains both low electricity prices and fuel diversity.
- Provides one of the largest investments in pollution control technology in history.





# *Clean Air Mercury Rule (CAMR)*



## *Benefits of CAMR*

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- CAMR will **build on EPA's Clean Air Interstate Rule (CAIR)** to significantly reduce emissions from coal-fired power plants -- the largest remaining sources of mercury emissions in the country.
- When fully implemented, these rules will reduce utility emissions of mercury from **48 tons a year to 15 tons, a reduction of nearly 70 percent.**
- EPA's modeling shows that CAMR will **significantly reduce the majority of the coal-fired power plant mercury emissions that deposit in the United States, and those reductions will occur in areas where mercury deposition is currently the highest.**
- CAMR is expected to make additional **reductions in emissions** that are transported regionally and **deposited domestically**, and it will reduce emissions **that contribute to atmospheric mercury worldwide.**
- Emission reductions occur while economic strength is preserved. U.S. maintains both low electricity prices and fuel diversity.



*The first-ever federal rule to permanently cap and reduce mercury emissions from coal-fired power plants.*



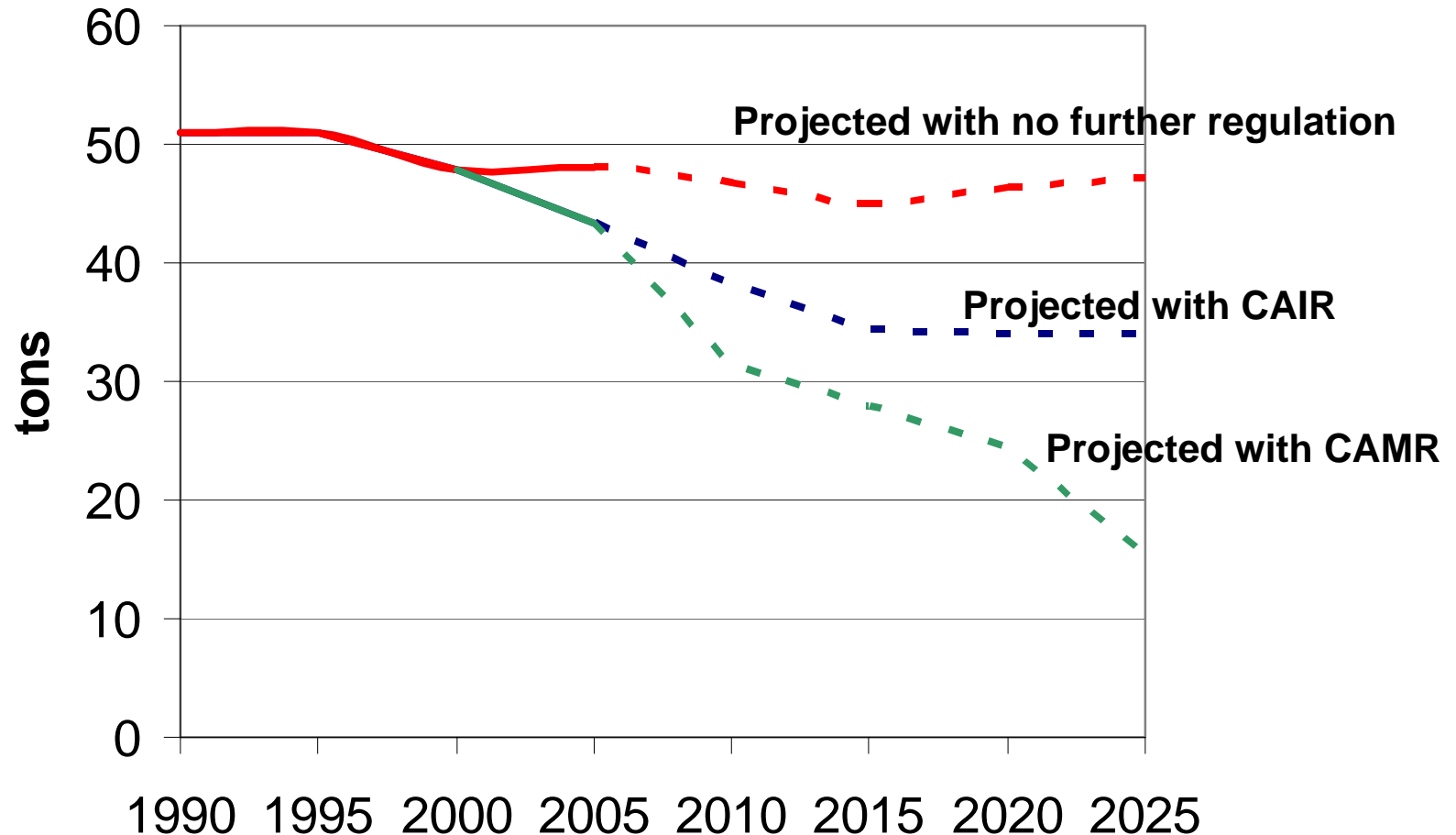
# *Key Elements of CAMR*

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- The Clean Air Mercury Rule establishes “standards of performance” limiting mercury emissions from new and existing coal-fired power plants and creates a market-based cap-and-trade program that will **reduce nationwide utility emissions of mercury in two distinct phases**.
  - **The first phase cap is 38 tons** and emissions will be reduced by taking advantage of “co-benefit” reductions – that is, mercury reductions achieved by reducing sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) emissions under CAIR – the new Base Case.
  - **In the second phase**, due in 2018, coal-fired power plants will be subject to a second cap, which will reduce emissions to **15 tons** upon full implementation.
- **New coal-fired power plants** (“new” means construction starting on or after Jan. 30, 2004) will have to **meet new source performance standards in addition to being subject to the caps**.
- CAMR **sets an emission reduction requirement for each State and Indian country**, by distributing the national emissions cap among the States and Indian country.
- CAMR provides **an optional cap and trade program** based on successful Acid Rain and NO<sub>x</sub> Budget Trading programs as a method to implement the necessary reductions.
- CAMR **allows States flexibility** on how to achieve the required reductions, including whether to join the trading program.



## *National Hg Power Plant Emissions: Historic and Projected with CAMR*



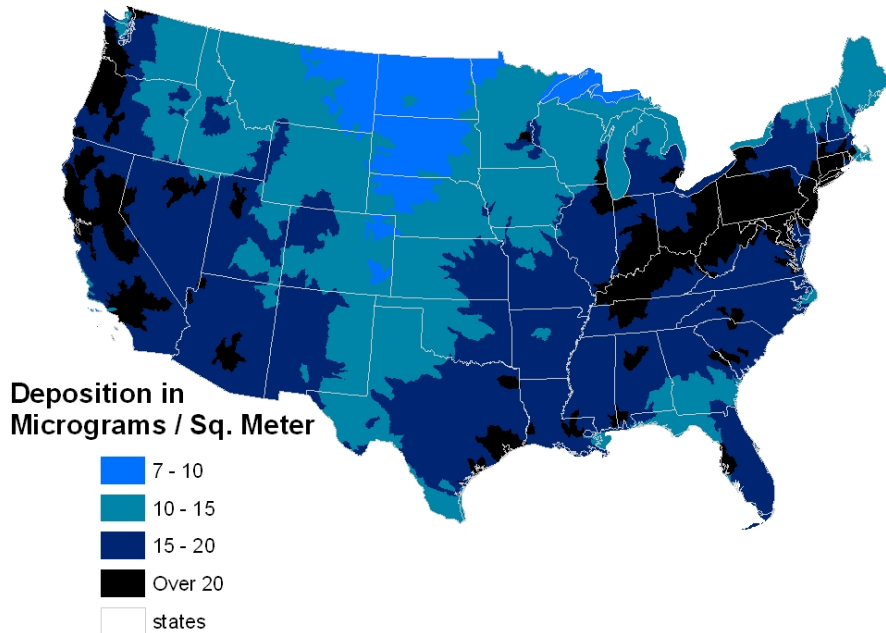
Source: EPA

**Note:** 1999 emission estimate for utility coal boilers is based on 1999 Information Collection Request (ICR); 1990 and 1996 are based on different methodology.

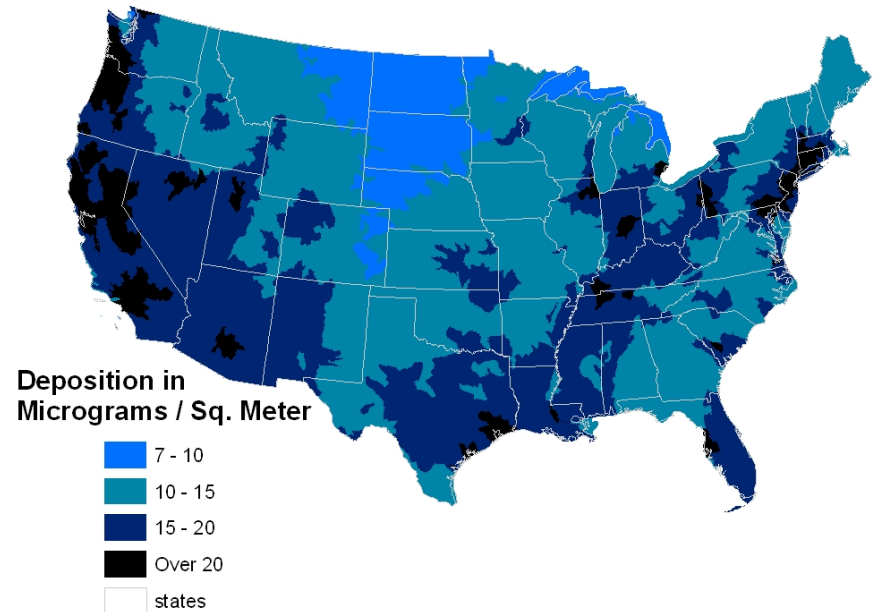


# Mercury Deposition in the U.S.

## Deposition From All Sources in 2001



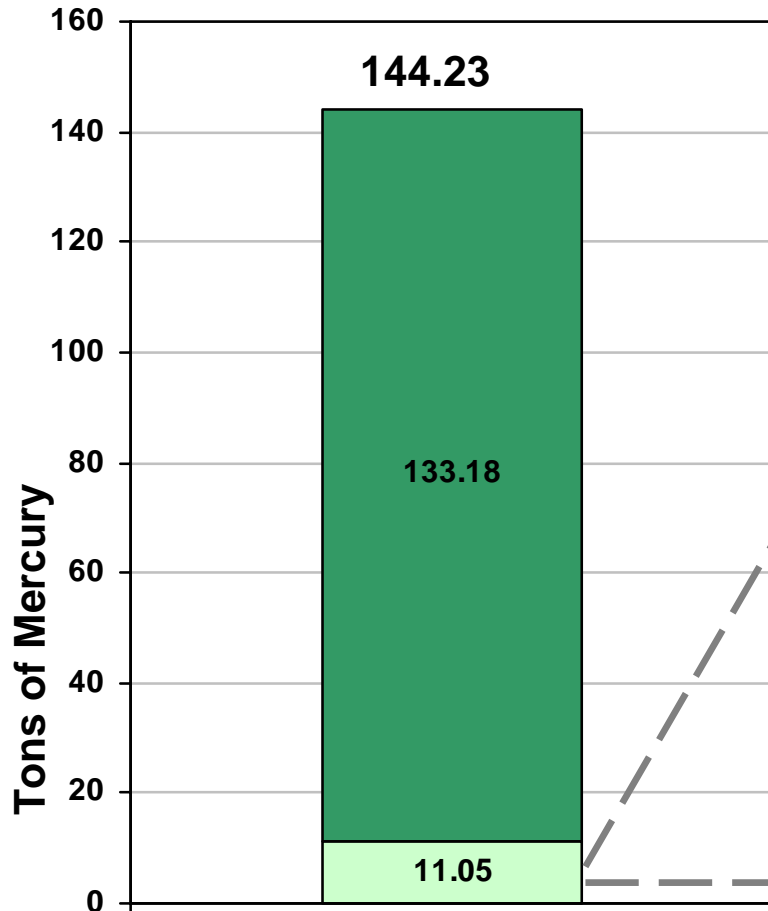
## Deposition From All Non-Utility Sources in 2001



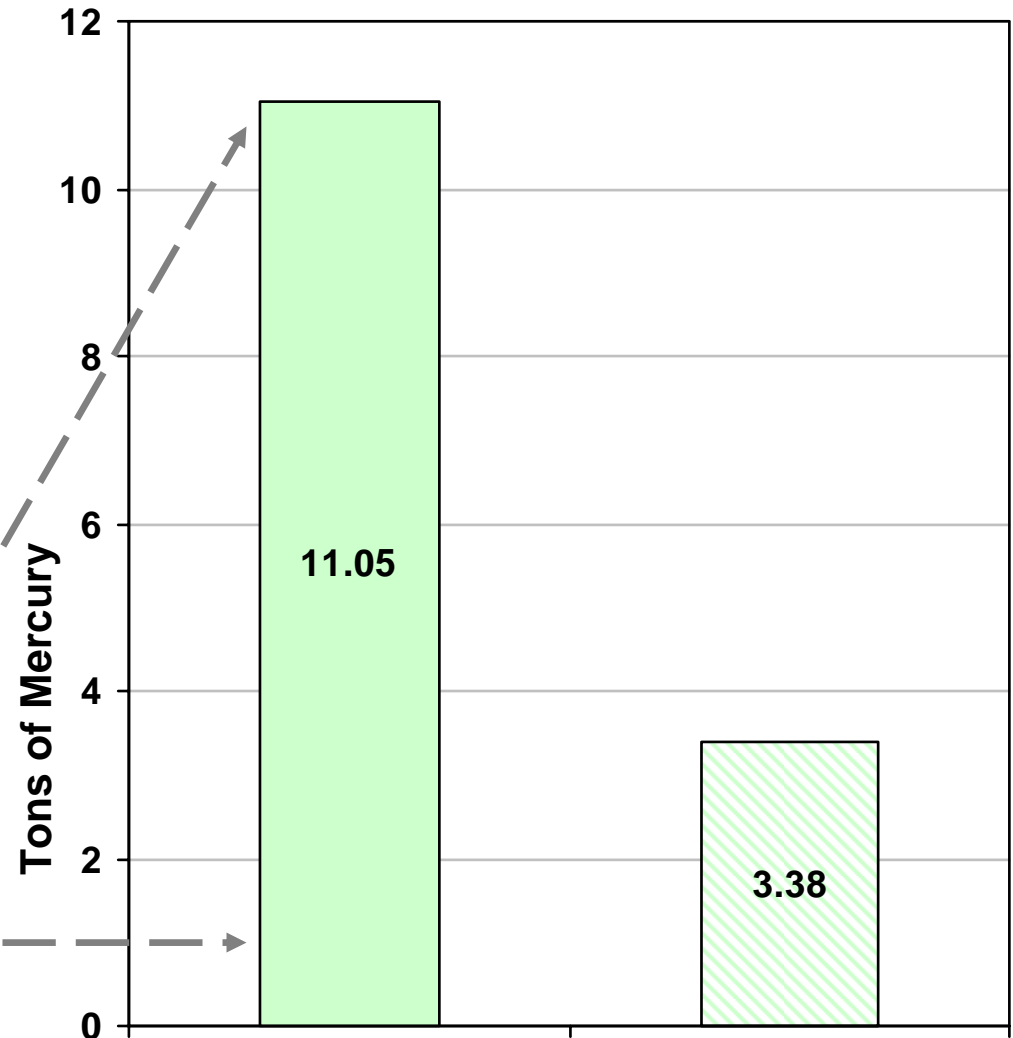


# Mercury Deposition in the U.S.

## Total Mercury Deposition in the U.S.



## U.S. Mercury Deposition from U.S. Utilities



■ = 2001 total deposition in the U.S. from all sources, domestic and global

■ = 2001 deposition in the U.S. from U.S. utilities

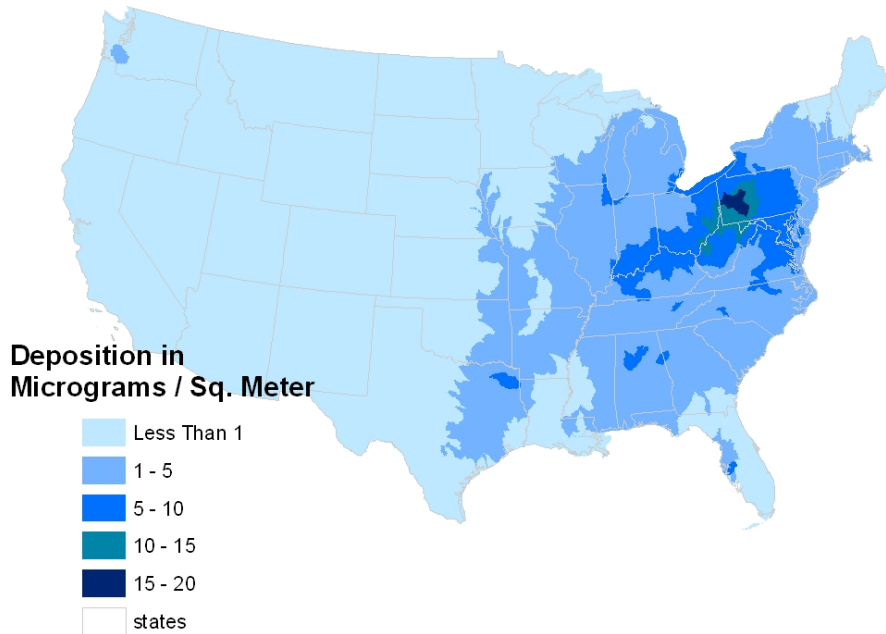
Source: U.S. EPA 2005

2020 deposition from U.S. utilities after CAIR, Clean Air Mercury Rule & other Clean Air Act programs

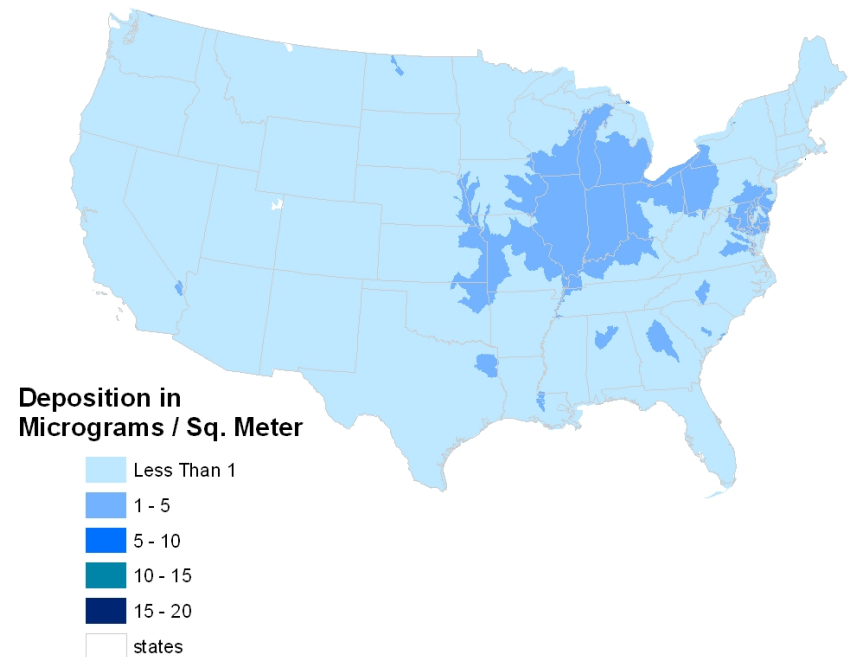


# Power Plant Mercury Deposition

## Deposition From Utility Sources in 2001



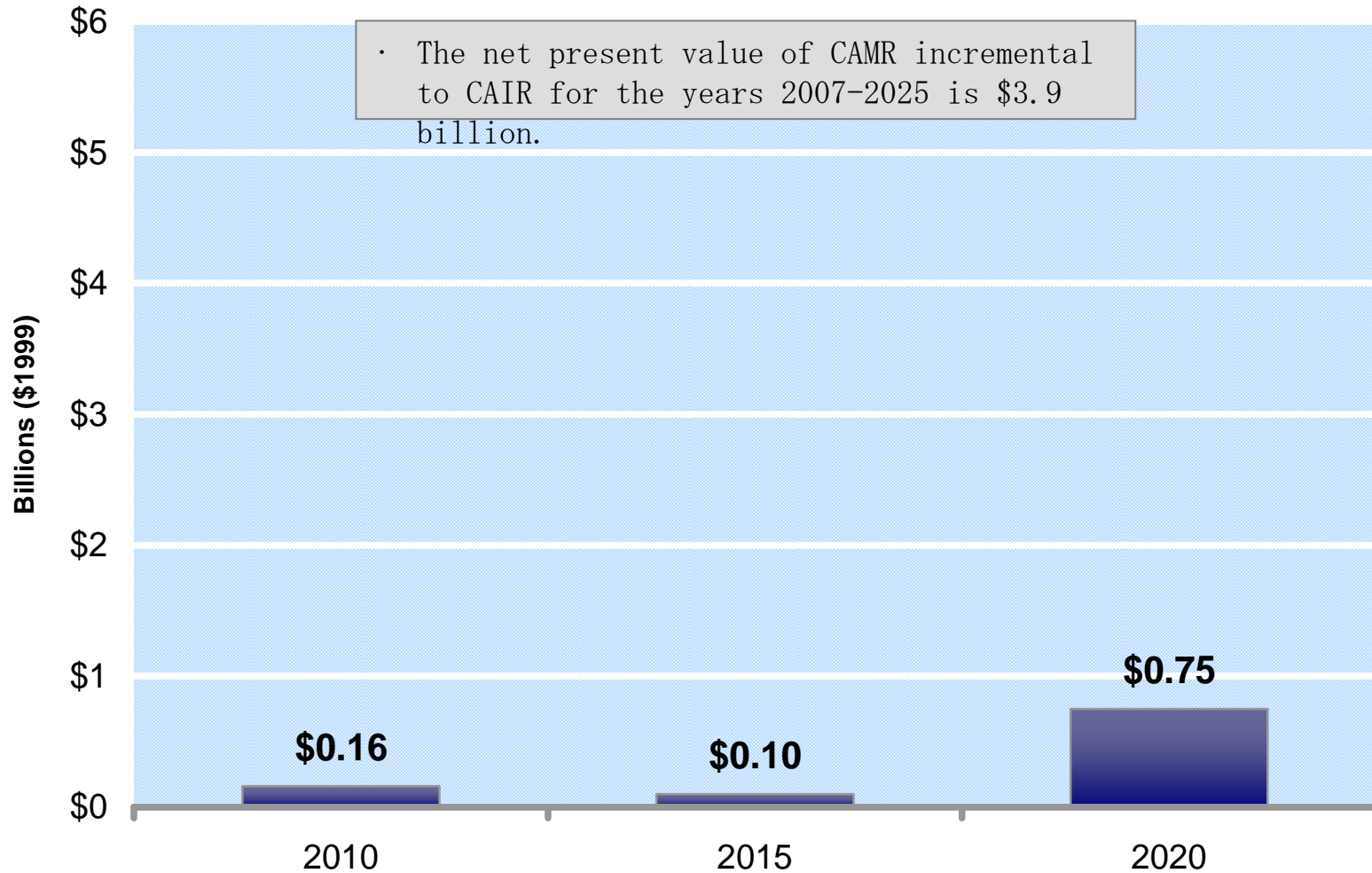
## Deposition From Utility Sources After CAIR, CAMR, and Other Clean Air Act Programs in 2020





# Annualized Private Cost of CAMR

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Note: From IPM, cost of CAIR is \$2.3 billion in 2010, \$3.6 billion in 2015, and \$4.7 billion in 2020, with a net present value of \$41.1 billion.



# Summary

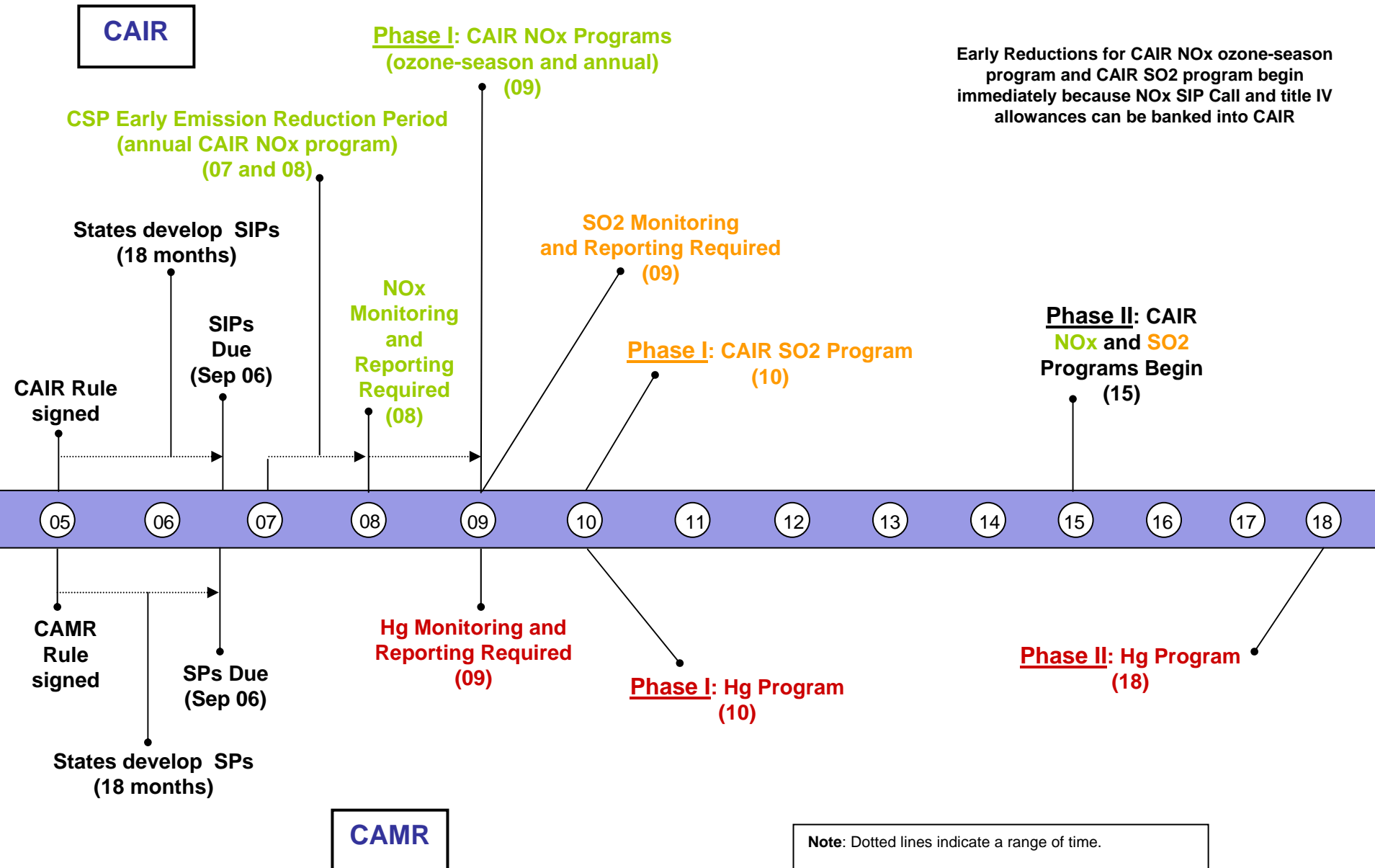
## **CAMR significantly cuts emissions of mercury from power plants and:**

- Builds on EPA's Clean Air Interstate Rule (CAIR) to allow power industry to address mercury, SO<sub>2</sub> and NO<sub>x</sub> emissions in a coordinated effort.
- Along with CAIR, will help protect public health and the environment without interfering with the steady flow of affordable energy for American consumers and business.
- Along with CAIR, is expected to make reductions in emissions that are transported regionally and deposited domestically, and it will reduce emissions that contribute to atmospheric mercury worldwide.





# CAIR and CAMR Implementation Timeline







**To Learn More...**

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**Clean Air Interstate Rule**

**[www.epa.gov/cleanairinterstaterule](http://www.epa.gov/cleanairinterstaterule)**

**Clean Air Mercury Rule**

**[www.epa.gov/mercury](http://www.epa.gov/mercury)**